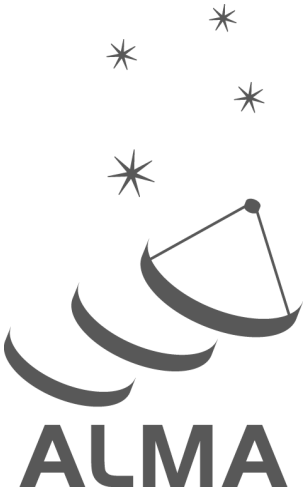
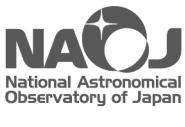
ALMA Status Update

October 2013





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ALMA, an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile.

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Revision History:

Version	Date	Editors
Ver. 1.0	October 2 2013	L. Nyman, J. Hibbard, M. Saito, P. Andreani, K. Tatematsu
Ver. 1.1	February 27 2014	L. Nyman, J. Hibbard, M. Saito, P. Andreani, K. Tatematsu

Contributors

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1 Summary

This report summarizes the status of Cycle 1 Early Science observations including events over the past few months, observing progress, an assessment showing the completion likelihood of Cycle 1 Highest Priority projects by Band, LST and requested angular resolution, and an announcement for a new plan to transfer uncompleted Cycle 1 projects into Cycle 2.

2 ALMA Cycle 1

Cycle 1 is the second Early Science period that was made available to the international ALMA community for PI science on a “best efforts” basis, meaning that priority is given to the completion of the full 66 element array and the commissioning and delivery of the full ALMA capabilities. Cycle 1 PIs share risk with ALMA, and project completion cannot be guaranteed.

Cycle 1 represents a significant upgrade compared to Cycle 0. Besides doubling the number of 12-m Array elements (with the concomitant increase in data rate), it also involves adding the ACA 7-m Array, the ACA TP Array, the ACA correlator, two additional quadrants of the 64-input Correlator, tripling the number of array configurations and doubling their extent. In addition, the infrastructure underwent significant improvements, such as adding the permanent power supply and power distribution system. In many ways, the increment from Cycle 0 to Cycle 1 was greater than that from commissioning-only observations to PI observing in Cycle 0, particularly from the infrastructure and software perspective. Commissioning of Cycle 2 capabilities continues in parallel.

Cycle 1 PI observing was originally planned to start in January 2013 and to span 10 months. However, the large increase in capabilities mentioned above and some poor luck with weather led to less rapid progress and revealed some unforeseen issues. As a result, a decision was made to spend several months giving priority to commissioning and improvements to infrastructure and overall system stability, and to extend Cycle 1 from the end of October 2013 to the end of May 2014. Notifications to this effect were posted to the ALMA Science Portal in April and May, and rebroadcast by the ARCs to their communities.

The reprioritization was largely successful and led to significant progress during April-May. With the understanding that software acceptance would be imminent, an announcement was posted to the Science Portal on May 31 stating that “Cycle 1 Early Science observing will resume at nominal priority in June 2013”. However, June & July brought further problems – weather & power related issues led to site closures and the subsequent warming of receivers. This severely limited the number of available antenna elements, which prohibited Cycle 1 PI observing and hampered progress in software acceptance.

The Cycle 1 software for 12-m Array observations was finally accepted on July 24. The software for ACA observations is believed to be ready for acceptance, but still needs a few key tests. Unfortunately August brought further power issues and a workers strike, bringing all observing to a standstill. The workers strike was resolved on September 8, and a status update was posted to the Science Portal the following day. The process to restore full operational conditions is on-going as of the date of this report. We anticipate the resumption of PI science observing for 12-m Array observations in early October, and ACA software acceptance (followed by observing of PI ACA projects components) shortly after that.

3 Observing Progress

Each project is organized into one or more observable sequences called Scheduling Blocks (SBs), which are executed as many times as needed to reach the requested sensitivity. In Cycle 1 there were originally 197 projects given the "Highest Priority" status. Two Highest Priority projects were canceled (targets no longer visible), while a single DDT proposal was added, leaving 196 Highest Priority projects, comprising 481 SBs requiring 810 executions.

As mentioned above, very little Cycle 1 science observing has been completed. All science observations taken thus far occurred prior to software acceptance and were considered test data until the software was verified and accepted on July 24, at which point they could be processed through the ALMA Quality Assurance stages for assessment and potential delivery to PIs. Table 1 shows the current status of observations and data delivery as of October 1, 2013. That an execution passed QA0 (or Quality Assurance level 0) means that the SB ran to completion on the telescope, produced an exportable dataset, and includes all necessary calibrators and spectral windows; that it passed QA2 means that the science target data passed the quality control assessment after calibration and imaging.

The large number of SBs that passed QA0 but did not pass QA2 was primarily due to the reduced sensitivity resulting from the less than nominal number of 12-m antennas that were available during the test observing period.

Table 1: Status of Cycle 1 projects as of October 1, 2013 (not considering ACA)

Priority=Highest, 12-m Array only	Projects	SBs	Executions
Total Number	197	481	810
Started (passed QA0)	27	33	66
Passed QA2 or delivered (partly or completely)	5	7	18
Completed	3	4	9

The Project Tracker is now available after logging into the ALMA Science Portal. It is accessed via a link under the "Observing" left-menu item. The tool provides information on the current state and any observing reports for the scheduling blocks associated with a project. A user manual is available from the tool's landing page. Later this season, the Project Tracker will become available also to Cycle 1 co-Is.

4 Data reduction

As in Cycle 0, Cycle 1 data reduction is done at the JAO and the three ARCs following standard data reduction scripts, conducting quality assurance checks, and packaging the data for delivery to PIs. This process is very time-intensive, but based on admittedly very small number statistics, the timescales have been reduced compared to Cycle 0. This is demonstrated in the table below, where we list the median timescales for each post-observing stage from project completion to delivery, both for Cycle 0 and for the seven Cycle 1 data deliveries.

The timescale from when the observations were completed to when they were assigned for data reduction is not listed above, since all of these data were taken in "test" periods before software acceptance and had to wait until the software was formally accepted on July 24 before they could be properly processed through QA2. Overall, data reducers report far fewer problems with data reduction, and the scripts are working well.

Table 2: Data Processing Timescales

Median Data Processing & Delivery times (days)	Cycle 0 (344 SBs)	Cycle 1 (7 SBs)
Days since available for assignment and QA2	45	16
Days since QA2 and Delivery	12	2
Total time (days)	68.5	17

The lull in data reduction has afforded the project the opportunity to provide more support to commissioning the ALMA Pipeline for calibrating ALMA data (imaging is a Cycle 2 deliverable). This is a pan-ALMA activity with experts at the JAO and ARCs all participating, and as a result excellent progress has been made both on the pipeline procedures, machinery, and heuristics. During Cycle 1 pipeline reduction will take place in parallel with the manual reduction, and the products compared to further refine and validate the pipeline procedures. It is possible that pipeline-assisted data reduction could be taking place by the end of Cycle 1, further reducing the data delivery timescales.

With the imminent resumption of PI observing, the regional ARCs and ARC nodes remind Cycle 1 investigators that they welcome visits for them to work on their ALMA data products. Visits by archival researchers are also welcome. Visit requests should be submitted using the ALMA helpdesk (http://help.almascience.org). If you receive assistance from an ARC or ARC node, please include this in the acknowledgements of any paper using the ALMA data. Also please remember to include the standard ALMA acknowledgement given at http://almascience.org/alma-data.

5 Array Configuration & Schedule

Six different 12-m Array configurations were advertised for Cycle 1 (see Cycle 1 Proposers Guide), with maximum baselines ranging from 160 m (configuration C32-1) to 1 km (C32-6). During the “reprioritization” period, the array was kept in an intermediate configuration with a maximum baseline ~400m (similar to the C32-3 configuration). However, the conditions at the site and construction issues have delayed the completion of antenna pads with baselines in the 500m-1km range, and it is unlikely that Cycle 1 projects requiring these baselines can be scheduled before March 2014. These account for ~40% of the Highest Priority scheduling blocks.

As for Cycle 0, Cycle 1 science observing is scheduled in blocks of one week every other week, with the off-week allocated to continued commissioning and engineering activities. A total of 20 observing blocks were originally planned for Cycle 1. If science observing resumes in early October and extends until the end of May 2014 we expect to have 14 science observing blocks (excepting February 2014).

During the science blocks, observing takes place in ~17hr periods from ~6pm-11am CLT. This is sufficient to cover most LST ranges in the remaining period allocated for Cycle 1. However, the LST range for a given configuration will be limited, particularly for the more extended configurations. Additionally, the remaining months are not particularly well suited to high frequency observing (see Fig 1 from Proposers Guide).

All of these circumstances suggest that it will be very hard to complete a significant fraction of Cycle 1 observations.

6 Cycle 1 Completion Analysis

Given the above factors, the JAO performed an analysis of the completion likelihood. The science goals for all remaining science observations were characterized by their mean LST, requested band, requested angular

resolution (i.e. configuration), and number of hours needed. These were compared with the likely configuration schedule (with the more compact Cycle 1 configurations until March 2014, followed by the more extended configurations), the hours scheduled for science observing (setting the LST ranges available), and the number of those hours expected to be available for each band (based on Fig. 1 from the Proposers Guide). Using this information, hours were assigned first to Highest Priority projects for the appropriate configuration and LST starting with the highest frequency band, then the next highest until all the hours were allocated. Any unassigned hours were assigned to Cycle 1 Second Priority ("Filler") projects.

The result of this exercise is a table of hours needed vs. hours predicted for each configuration and band as a function of LST. The ratio of these two numbers is the completion likelihood. All of these quantities are plotted in Figure 1 (for each Band) and Figure 2 (for each configuration).

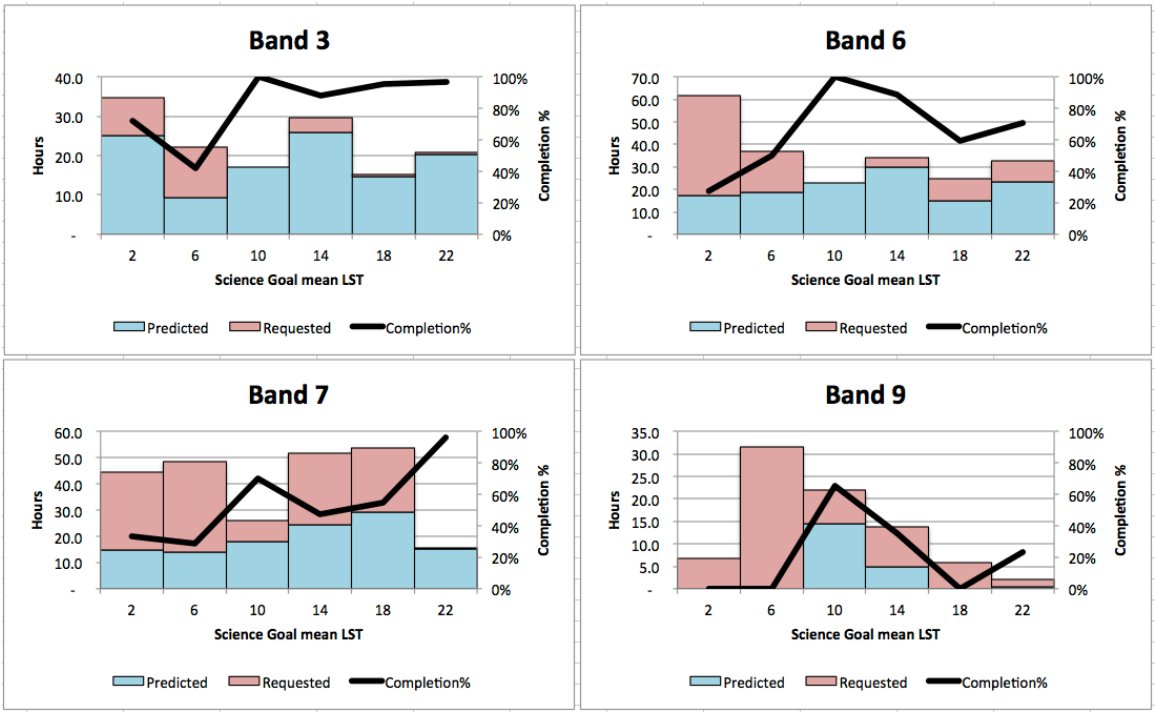

Figure 1: Prediction of Cycle 1 completion percentage, as a function of observing Band. The blue histogram shows the number of hours predicted to be completed in a given 4-hr LST range, while the red histogram shows the number of hours that were requested by Cycle 1 Highest Priority projects. The black line shows the resulting completion percentage.

According to this analysis, the overall completion likelihood for Highest Priority proposals is 56% (375 hrs completed compared to 675 hrs needed), but this is a strong function of configuration, band and LST (see Figs. 1 & 2). On the positive side, 43% of Filler science goals are predicted to be completed (136 hrs completed compared to 319 hrs needed).

This assessment quantifies the concerns raised above, that in the remaining time allocated to Cycle 1, the availability of suitable observing conditions, configurations, and LST ranges may lead to a low completion percentage, particularly at certain requested angular resolutions, frequencies and LSTs. In the above exercise, 300 hrs of Cycle 1 Highest Priority science goals remain unobserved, consisting of 30 hrs of observations in Band 3, 90 hrs in Band 6, 120 hrs in Band 7, and 60 hrs in Band 9.

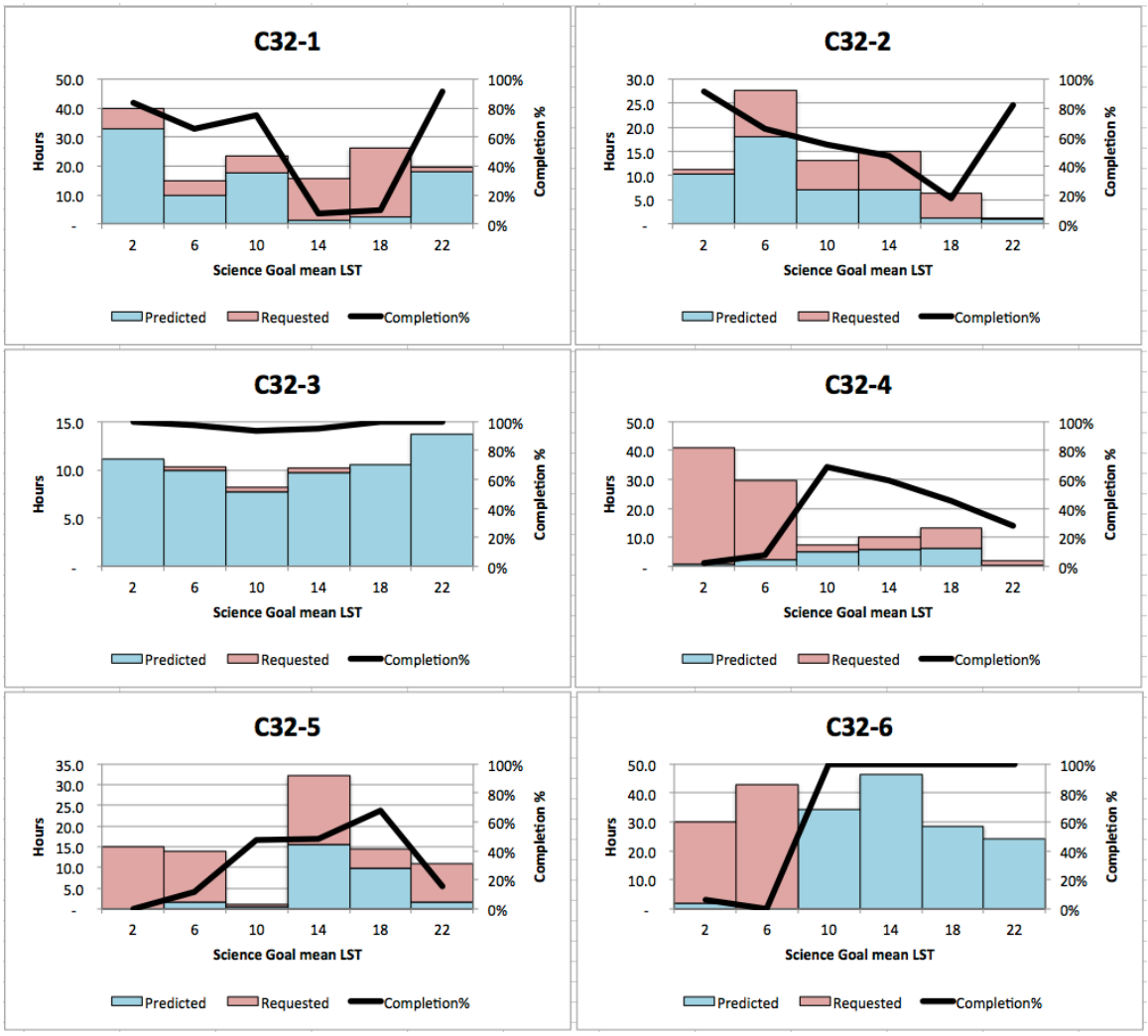

Figure 2: Prediction of Cycle 1 completion percentage, as a function of desired configuration (based on user requested angular resolution). C32-1 has the shortest baselines (lowest angular resolution) and C32-6 has the longest baselines (highest angular resolution). The blue histogram shows the number of hours predicted to be completed in a given 4-hr LST range, while the red histogram shows the number of hours that were requested by Cycle 1 Highest Priority projects. The black line shows the resulting completion percentage.

7 Transfer of Cycle 1 Highest Priority into Cycle 1

Because of the above considerations, and because we do not wish to delay the start of Cycle 2 any further, the project has decided to offer Cycle 1 PIs the opportunity to designate their projects as eligible for transfer from Cycle 1 into Cycle 2 in the case that they are not completed by the end of Cycle 1.

The following conditions are imposed on projects that PIs wish to designate for “Cycle 1 transfer”:

1. Only Cycle 1 PIs (not co-Is) can designate their projects as eligible for transfer into Cycle 2.
2. No Cycle 1 projects will be transferred beyond Cycle 2.
3. Any Cycle 1 Highest Priority proposal is eligible to transfer to Cycle 2 (does not depend on observing band, target LST, or configuration).
4. No Cycle 1 DDT or second priority (“Filler”) projects may be designated for transfer into Cycle 2.

5. Whether or not Cycle1 projects are designated for transfer does not affect their rank or grade, and therefore does not affect their scheduling priority in Cycle 1.
6. Projects designated for transfer ultimately have a much higher probability of being completed. Therefore their metadata will be made public so that other proposers do not submit Cycle 2 proposals that duplicate these observations. This includes proposal abstracts, target positions, frequency setups and requested angular resolution and sensitivity.
7. PIs who do not elect to designate their proposals for transfer will retain the data policy rights advertised in the Cycle 1 call materials; in particular, their metadata will not become public until the first observations are archived, and then only the metadata associated with the successful observations will be made public.
8. Projects must be designated for transfer by October 31, 2013 so that a "duplication list" of targets (positions and frequency setups, etc) can be published on the Science Portal for potential Cycle 2 proposers to check against. PI's who do not designate their projects by this date will not be eligible for transfer into Cycle 2.
9. The relative ranking of projects in Cycle 2 will proceed as follows:
    a. Cycle 2 "A" proposals (~10% of Cycle 2 "Highest Priority" projects)
    b. Cycle 1 transfers
    c. Cycle 2 "B" proposals (remaining ~90% of Cycle 2 "Highest Priority" projects)
    d. Cycle 2 "C" proposals

    During scheduling, the project with the highest scientific rank is observed whenever all other factors taken into account like weather, configuration or target elevation are equal (see Proposers Guide).
10. For Cycle 1 projects transferred into Cycle2, change requests are not permitted for any of the additional Cycle 2 capabilities (e.g. 1.5 km baselines, bands 4 or 8, polarization).
11. Cycle 1 transfers are still subject to the same "best efforts/shared risk" aspect of all Cycle 2 proposals; in particular project completion cannot be guaranteed.

Cycle 1 projects that are not transferred will be marked as "fully observed" at the end of Cycle 1 (May 31, 2014), and all associated data will be processed and delivered whether or not they pass QA2. For projects that are transferred into Cycle 2, data will be delivered once a project component has been completed and passed QA2, even if the observations started during Cycle 1 and concluded during Cycle 2. If any Cycle 1 transfers remain unfinished at the end of Cycle 2, they will be marked as "fully observed" and all associated data processed and delivered (whether or not they pass QA2).

Each Cycle 1 project has a Contact Scientist at the ARCs or ARC nodes. These Contact Scientists will immediately begin contacting their PIs through the helpdesk to determine whether they would like to designate their project for transfer into Cycle 2. These proposals will not need to be resubmitted, and the project number will not change. At the end of Cycle 1, all projects designated for transfer into Cycle 2 will need to have their Phase 2 products regenerated, but renewed PI approval is not required.

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI) and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.